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Drawings as representations of children's conceptions

Introduction

Drawings are often used when our primary research interest is children's conceptions (e.g., Arnold, Sarge & Worall, 1995; Dove, Everett & Preece, 1999; Halldén et al, 2002; Klein, 1982; Sneider & Pulos, 1983; Vosniadou & Brewer, 1992). This tradition has recently received methodological and theoretical criticism. Dove, Everett and Preece (1999) discussed their own results in a study of children's understanding of a river basin, a concept linked to the water cycle. Drawings of snow-covered mountains with sharp peaks were common. Dove and colleagues questioned whether the children really believed that mountains were as they drew them, or if they were using a clichéd representation. They pointed to the fact that stereotypical images are not always incorrect representations, but there is a danger that this kind of picture prevents children from recognizing the rich variety in the real world. Siegal, Butterworth and Newcombe (2004) focused on a methodological problem in studies of children's conceptions of the Earth. They maintained that the use of drawings might lead to overrepresentation of a flat-Earth concept among children. They argued that children's difficulties in drawing a sphere could lead them to produce something that appears to be a flat Earth. They also questioned whether a drawing of a person standing on a flat surface indicates that children believe that the Earth is flat; rather, it may simply reflect the children's ambition to orient figures to baselines. From a socio-cultural standpoint, Ivarsson, Schoultz and Säljö (2001) have objected to drawings being regarded as mirroring underlying conceptions. Instead they argue that drawings should be looked upon as cultural tools, which contribute to answers. Vosniadou, Skopeliti and Ikospentaki (2005) responded to the criticisms of Siegal et al (2004)

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and Ivarsson et al (2001) by pointing to the question of how drawings are used to get an idea of children's conceptions. Studies by Vosniadou and colleagues analysed drawings together with children's comments.

Drawings as representation

If drawings are to be used for learning about children's conceptions, we must know how children represent their conceptions in drawings. Piaget and Inhelder (1966/1969) described children's representation as the semiotic function, which is the capacity to represent a signified entity with the help of a signifier. They distinguished between symbols (i.e., signifiers that have some link to what they represent) and signs (i.e., signifiers that are arbitrary and have a conventional relation to what they represent). Symbols can be creations of the individual child, whereas signs are conventional and collective.

Luquet (1927/2001) argued that there are different methods of representation in children's drawings. What he calls a *visually realistic* picture is like a photo, where what is rendered is seen from one perspective. In *intellectually realistic* pictures children show what they hold as the most important characteristics, and different techniques can be used for this. To show parts of an object that cannot be seen from only one perspective, the child can use transparency, plan view, folding out or mixed viewpoints. These techniques are illustrated by the findings of Dove et al (1999) concerning the concept of a river basin. In their study, a majority of the 306 children, aged 9 to 11 years, used mixed viewpoints in their drawings. Mountains, trees, houses, fish and boats were depicted in side view; the river was either in side view or seen from above, in plan view; the sea, the river's outlet and the roads were shown in plan view. Although Luquet identified the techniques of intellectual realism in children's drawings, they also appear in adults' pictures. Examples are architectural or

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technical drawings, whose producer shows the inside of an object or the same object from more than one viewpoint. Therefore, Luquet questioned whether the different methods were not better described as conventions from which the child chooses, than as steps in intellectual development.

Investigating the role of conventions in art, Gombrich (1960/1977) argued that artists describe the world with the help of a system of schemata. "[T]he starting point of a visual record is not knowledge but a guess conditioned by habit and tradition" (Gombrich, 1977, p. 77). According to Gombrich, artists apply different schemata through corrections to their initial picture. He argues that it is impossible to make a picture without having learned how to do so from other pictures. Likewise, Thomas (1995) suggested that children's drawings translate neither internal representations nor visual impressions. He cites studies showing that better visual knowledge of an object to be represented does not improve children's drawing. Rather, in order to make a good drawing the child apparently needs instructions on how to draw that particular object. Presenting an absolute idea of pictures as conventions, Goodman (1976) argued that pictorial representation is a conventional system of symbols to the same degree as verbal descriptions are. According to him, resemblance is neither a necessary nor a sufficient condition for depiction: the only criterion for representation is reference to an object.

Because a photographic or visually realistic picture is also a consequence of the choice of a mode of depiction, this study views visual realism as one convention among other pictorial conventions and genres. This implies that how children represent their conceptions is a question of what convention they choose for depiction. In order to study how children choose among drawing conventions to express their conceptions, a theory that includes both cultural and cognitive aspects will be used. Halldén (1999) distinguished between different contexts in children's learning of concepts. In a cognitive context, concepts are contextualized

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in conceptual frameworks. Possible frameworks for the concept Earth are for example the astronomical framework of the planet Earth and the common sense framework of the Earth as nearby surroundings. In any situation, it is the acting person's judgement of different explanations' relevance that leads to the actualization of a certain conception. In a cultural context, verbal descriptions are contextualized in different speech genres or ways of talking. In the same way, visual descriptions are contextualized in different pictorial genres, in which different modes of depiction may be used. A biological drawing of a cell may be in a transparent mode of depiction, in Luquet's terminology; intellectually realistic, while a zoological bird drawing may be in a photographic mode of depiction, in Luquet's terminology; visually realistic.

Aim of the study

The aim of this study is to investigate how children represent their conceptions in drawings. This means that different contexts will be considered. Children's drawings will be seen as contextualized in pictorial conventions, and children's conceptions will be seen as contextualized in conceptual frameworks. To become aware of how children represent their conceptions in drawings, we will study how children choose pictorial conventions to represent their conceptions in a given situation.

Children's conceptions of the Earth

One area where children's conceptions are well researched and where drawings have been used as a methodological means for such research is the understanding of the concept of Earth. Studies in a constructivist tradition have shown that children may have trouble

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understanding a scientific astronomical concept of the Earth (e.g., Mali & Howe, 1979; Nussbaum, 1979; Nussbaum, 1985; Nussbaum & Novak, 1976; Sneider & Pulos, 1983; Vosniadou, 1994; Vosniadou & Brewer 1992). Children are said to often use alternative models based on interpretations of their own experiences. Vosniadou and Brewer (1992) described five such models of the Earth. The rectangular Earth and the disc Earth are initial models that children use before they receive information about the planet Earth. When children are informed about the planet, they may combine this information with suppositions based on their earlier experiences. In this process, according to the research by Vosniadou and Brewer, synthetic models (i.e., the dual Earth, the hollow Earth and the flattened sphere) may appear.

Halldén and colleagues (2002) introduced a model for conceptual differentiation through contextualization. They propose that the problem for children is finding the appropriate conceptual framework for different pieces of information about the Earth. During the process of differentiation, children gradually realize that we can talk about the Earth in different conceptual contexts e.g., in a common sense framework and in an astronomical framework. Contrary to the model of Vosniadou and Brewer, Halldén and colleagues maintain that the process of differentiation does not involve the child's abandoning the concept of a flat Earth in favour of a scientific concept. Rather, children use the conception of a flat Earth in their everyday surroundings; but at school (e.g., in science classes) they might use the concept of a spherical planet. In addition to the differentiation between a theoretical framework and a common sense framework for some concepts there may be a need to differentiate between different theoretical frameworks. For example concepts related to natural resources are often contextualized in either a biological framework or an economical framework. This description of concept formation is in line with constructivism, as it attributes conceptions to the individual. However, like socio-cultural researchers' view, this model acknowledges the

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decisive role of physical and cultural surroundings, as the individual applies a conception in line with her or his own understanding of the situation.

When the aim of this study is described in a theory of contextualization, with children's understanding of the Earth as empirical example, the following research questions are formed:

1. How do children contextualize their conceptions of the Earth in conceptual frameworks?
2. How do children contextualize their drawings of the Earth in pictorial conventions?
3. How do they relate the contextualization of their conceptions of the Earth to their contextualization of their drawings in pictorial conventions?

Method

Data to describe children's contextualization of their conceptions in conceptual frameworks, and to contextualize their drawings in pictorial conventions, were obtained by interviewing children in Sweden while they were drawing the Earth. This method was preferred to a technique that would have interviewed children about their drawings after they were finished, because it was presumed that the children's considerations during the drawing process might otherwise be lost. Eighteen children with varied social backgrounds from urban, but not inner city, surroundings were interviewed. The children were from six to nine years old. All participating children volunteered, with their parents' consent, to take part in the study after they and their parents had been informed of the study. While they were drawing, the children were interviewed in a semi-structured way. The interviews were intended to follow the child's own interest more than a predetermined set of questions, but nevertheless they focused on the children's understanding of the Earth and their choice of pictorial convention. The chosen method does not imply that the children's conceptual frameworks have to be stable during the entire interview (cf. Welzel & Roth, 1998). Rather, the theory of contextualization

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presupposes that conceptions may be contextualized in different frameworks during the same conversation.

Initially the children were asked if they knew what the Earth was, and if they could draw it. A few children needed more conversation about the subject than just this direct question before they had an idea of something to draw. The children had access to paper in A3 format and crayons of different colours. They made one, two or three drawings of the Earth. Those who drew more than one picture usually did so after the interviewer had encouraged them with such questions as, "Can you draw the Earth in another way?" or "Can you draw what it looks like where people are?" One child drew a straight line depicting the Earth as the ground in two pictures. Seventeen of the children drew a form similar to a circle. Most of these forms contained green and blue areas, and the children explained that the blue represented sea or water, and the green denoted land, country or grass. Nine of the children who drew a round Earth on one paper also drew a flat ground, seen in a side view, on another paper.

The interviews were audio-recorded and transcribed. Short notes about what had happened were written down, mainly immediately after the interviews. Often occurrences could also be deduced from the dialogue and the drawings. With this material it was possible to describe the children's acting in the given situation. Acting is distinguished from other behaviour in that an intention behind the action is acknowledged. "Given the action, we 'look back' on the grounds and reasons which make it intelligible." (von Wright, 1989, pp. 804, 805) This means that an intentional model of analysis can be used (Halldén, 1999; Halldén, Haglund & Strömdahl, 2007; Ryve, 2006). Considering the children's actions in the situation made it possible to consider not only the children's cognitive ideas, but also their views of the physical and cultural constraints of the interview situation. The utterances and the drawings were made in a situation in which certain rules for talking, drawing and behaving interacted; and what the children said and drew resulted from their interpretation of this, together with

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their knowledge of the Earth, drawing conventions and anything else they found relevant in the situation. What the children said about the Earth was related to conceptual frameworks, and was compared to earlier research (e.g., Nussbaum, 1985; Vosniadou & Brewer, 1992). Indications of reasons for the children's choice of mode of depiction were scrutinized. The children's contextualization of the mode of depiction in pictorial genres was compared to their contextualization of conceptions in cognitive contexts.

Results

For presentation in this section are chosen the eight children, from whom it was possible to give the clearest descriptions of different ways of relating contextualizing of conceptions in conceptual frameworks to contextualizing drawings in pictorial conventions. Thus the criteria for choice of examples were clearness and variation.

When describing the conceptual contextualization, the astronomical framework of the planet and the common sense framework of the Earth nearby are considered. In addition to this the material made it urgent to reflect on the differentiation of the concepts country, earth and planet. Findings in earlier research on the children's development of the concept earth are given as comparison when appropriate.

When describing the contextualization of drawings in pictorial conventions Luquet's concepts visual and intellectual realism are used. The intellectual realism is specified as for example mixed view-points or transparency. Pictorial conventions are also regarded as broader genres, like an astronomical scientific genre compared to a science fiction genre.

The children are presented under pseudonyms.

Differentiated conceptual frameworks and a visually realistic mode of depiction

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Two children explained the difference between the Earth nearby and the Earth as a planet as a difference in distance. Elin (age 7) drew a girl on a hillock in her second drawing. When asked why the Earth was round in her first drawing but only a bit bent in her second drawing, she said (about her first drawing), "This is from a great distance. Then you don't see the hillock." (Nevertheless, after this question she added the girl and the hillock to her first drawing.) When asked if there were any people in his picture of a round Earth, Erik (age 9) said, "They can't be seen in this little picture." After that, he drew people covered by a magnifying glass in his picture of the round Earth — a "close-up," he called it. These children's explanations indicate that their conception of the Earth was of one object, which can be depicted as round from a great distance, and with details as people visible from a short distance. Their descriptions of the their drawings shows that they had differentiated the astronomical conceptual framework of the planet Earth from the common sense framework of the Earth as nearby surroundings, and that they also understood the relation between these frameworks. Before the interviewer's suggestions they drew the planet Earth in a visually realistic mode of depiction, and only after reservations or specified explanations did they add people to their drawings of the planet Earth. The additions of people in the drawings of the planet changed the mode of depiction in the drawings to an intellectually realistic mode of depiction. This was because the people and the planet were depicted from different viewpoints and distances. These children appeared to have differentiated and related the conceptual frameworks of the Earth, and they preferred to represent it in a visually realistic mode of depiction.

Undifferentiated conceptual frameworks and visually realistic depiction

[Insert figure 1 about here]

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Gunnar (age 7) made a round Earth with green and blue areas in his first drawing. He said that the green areas depicted grass. A round Earth is a convention for the planet, but “grass” does not belong to the astronomical framework of the planet Earth. Instead, it belongs to the framework of the Earth as nearby surroundings. When asked if there were any people, he said that they were "on the grass." He did not, however, draw any person on this round Earth. This means that his drawing of the Earth was from one perspective, that is, in a visually realistic mode of depiction. The interviewer asked him about the roundness.

I: How can it be that this one looks round, but that it looks straight and flat where we are?

Gunnar: There are sides on the Earth that may look straight.

I: The sides of the Earth look straight?

Gunnar: If there is a downhill slope, you can see that there is a bend on the Earth.

Gunnar explained the interviewer's proposition that the Earth looks straight and flat where we are by saying that "sides on the Earth may look straight." But he also stated that we can see the Earth's roundness in "downhill slopes." These comments indicate that he did not associate roundness with the planet as distinguished from the flatness of the Earth nearby. His explanation can be compared to what Nussbaum (1985, p. 179) found in his studies: children who said that the Earth was round, but who believed that we live on a flat Earth, explained the Earth's roundness by saying, "The Earth’s roundness is just the roads’ curves," or, "The Earth’s roundness is just the mountains’ shapes." Gunnar appeared not to have differentiated the astronomical framework of the planet from the common sense framework of the Earth nearby. His drawing of the Earth, however, was in a realistic mode of depiction, and could be connected to conventions for drawing the planet.

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Indra (age 6) drew a round Earth in her first picture, the interviewer asked her about people. She responded that there might be people in space.

I: Yes, but there are no people in your picture.

Indra: No.

I: There are none. So where are the people? Those who are not in space? Like you and me, where are we?

Indra: Here, inside the Earth.

Thus, she appeared to have meant that people were inside the round Earth that she had drawn. She did not add people to her drawing of the round Earth, when the interviewer asked her about people. She developed her ideas in connection with her second drawing, in which she drew a picture of a woman, who she said depicted the interviewer; then the interviewer asked her:

I: This one that you drew before, the big one with grass and water…

Indra: Yes, that one.

I: Can I not see that one?

Indra: No, because you are inside it.

In her second picture, which showed the interviewer, she also drew a sun. When the interviewer asked her if the sun was inside the Earth, she answered, "Yes, because you can see it." This comment indicates that she meant that everything that could be seen in her second drawing -- the interviewer standing on the ground and the sun in the sky -- was inside the Earth that she had drawn in her first picture. This can be compared to the model of the hollow sphere in Vosniadou's and Brewer's (1992) research on children's conceptions of the earth. Indra's comments about the sun and the interviewer as being inside the Earth indicate that she had not differentiated the astronomical framework of the Earth from the common sense framework of the earth nearby. Her drawings, however, can be related to different

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conceptual frameworks of the Earth; the first picture to an astronomical framework and the second to a common sense framework of the Earth nearby (cf. Halldén et al., 2002). Because of this, she can be described as having contextualized her conceptions of the Earth in undifferentiated frameworks and her drawings of the Earth in visually realistic conventions for depicting the Earth.

Albert (age 8) drew a round Earth. Explaining how the Earth rotated, he said that people did not go under the Earth even though it rotated. Then the interviewer went on to ask him where people were. Albert said that they were "on the Earth, here inside." He did not draw any people on his picture of a round Earth. Because he had used the word "inside," the interviewer asked him what was outside, and he said, "This is," indicating his drawing of a round Earth. When the interviewer asked him what the Earth was when he looked around himself, he said it was the sky and the air; and when she was asked in what direction he should look to see the Earth, he first said, "up," but then changed his mind to "ahead." Also Albert appeared to have a conception of the Earth similar to the descriptions of a hollow sphere by Nussbaum and Vosniadou & Brewer and he seemed not to have differentiated the conceptual framework of the planet from that of the Earth as nearby surroundings. It was, however, not until he told the interviewer that what could be seen in his drawing was the outside of what he meant was the Earth, that this became apparent. This was because his drawing of the Earth was in line with visually realistic depictions of the planet.

Halldén et al (2002) described the development of the concept of Earth as a process, wherein the intuitive conception of a flat Earth is not abandoned in favour of the scientific concept of the planet Earth. All information about the Earth is assimilated into an all-embracing model. The development of the concept of the Earth involves a process of differentiation, by which the child starts to realize how the Earth can be contextualized in both the common sense framework of the Earth nearby and the astronomical framework of the

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Earth as a planet. What Gunnar, Indra and Albert said about the Earth can be taken as an illustration of this process. These children may not yet understand what qualities of their conception of the Earth belong to the Earth nearby, and what qualities belong to the planet Earth in an astronomical framework. That this process of differentiating and relating the different conceptual frameworks of the Earth is only at an early stage is not possible to conclude from their drawings.

Undifferentiated conceptions of Earth, country and planet and visually realistic depiction

[Insert figure 2 about here]

When Annika (age 7) was asked if she knew what the Earth was and if she could draw it, she started her drawing with one big circle and said, "There is the sun." After that she said, "Then one makes the planets around," and she made 10 smaller circles around the first big circle. She wrote the Swedish word for "sun" inside the big circle and when the interviewer asked her which was the Earth, she wrote "joden," which is a misspelling of the Swedish word for Earth, near one of the smaller circles. She coloured this circle (Figure 2) and told the interviewer what could be found on the Earth: grass, earth (soil), trees, flowers, plants, fir trees, Christmas, water, a forest called the rain forest and a store of sweets or a country of sweets. Then she talked about Spain, and going there by aeroplane. When her picture and verbal description of the Earth seemed to be finished, the interviewer asked her:

I: On this one [indicating the coloured circle], are there all the things you told me about? What was it, the country of sweets, the rain forest?

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Annika: Yes.

I: And Spain.

Annika: Maybe not exactly on this Earth, maybe on the next Earth. Which is situated up here [indicating the circle just above the coloured one].

I: Is that an Earth, too?

Annika: Yes, all these small ones are Earths (Swedish: jordar).

I: Well, why did you draw so many Earths then?

Annika: There are pretty many around the sun.

This means that she changed her earlier explanation, now saying that the smaller circles depicted Earths, rather than planets. Because she had said that Spain perhaps was not on the Earth that she had coloured, the interviewer asked her if one could travel between the Earths.

I: But can you go from one Earth (Swedish: jord) to another?

Annika: Yes, you can.

I: How do you do it, then?

Annika: Go by aeroplane.

I: And then you go by air…You can show it on this one that you have drawn…If you, for example, go to Spain, can you draw how you go by air then…from…Which Earth do you live on?

Annika: Here.

I: Make a cross where you live.

Annika: Yes. [She makes a cross on the coloured Earth.]

I: You live there.

Annika: Yes.

I: And then you will go by air to Spain.

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Annika: Then the plane goes there over to the Earth. [She draws a plane, which looks like it is leaving the coloured Earth in the direction of the circle just above, where she has said that Spain is situated.]

What Annika early in the interview had called planets around the sun she later explained to be Earths, and she placed countries on different planets/Earths. Although she gave a new explanation of what the smaller circles represented, they were represented by the same drawing. This indicates that she did not differentiate her conception of planet from her conception of Earth, something which could not be concluded from her drawing without her own explanation.

Jakob (age 7) began by drawing a rather round Earth with blue, green and brown areas, explaining that they represented water, grass and Earth (Swedish "jord" may be translated into either "Earth" or "soil" in English). When the interviewer asked him if the Earth could be drawn in another way, he responded that it was possible without brown, and drew a second round Earth with blue and green areas, explaining that they represented water, grass and trees. This indicates that the brown areas in his first drawing represented earth/soil. He also talked about the earth where the ants lived. Later he spoke about going by boat or aeroplane to different countries. He had pointed out Sweden and Tunisia in one of his pictures of the Earth. Because he had drawn two different pictures of the Earth and talked about the earth where the ants lived, the interviewer wanted a clarification about which Earth the travelling could be related to.

I: But if you go by air from Sweden to Tunisia, then you travel above the Earth?

Jakob: Yes.

I: Then which Earth is it that you travel above?

Jakob: The Earth of Sweden.

I: Well, and the Earth of Sweden, what does it look like?

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Jakob: Round.

I: It is round too?

Jakob: Yes. All planets are round.

I: Yes, but are there two then? There is the Earth of Sweden, is it the same as the Earth of Tunisia?

Jakob: No, because in Tunisia it is warmer and in Tunisia there is never snow.

After a while, he told the interviewer that he had gone by boat to Finland, and the interviewer asked him to explain.

I: But if you go to Finland, then you travel over water?

Jakob: Yes.

I: Is it the same Earth in Finland as in Sweden?

Jakob: Yes, because Sweden and Finland are near each other.

Jakob explained that Tunisia and Sweden were not the same Earth, while Sweden and Finland were. According to Jakob this was because in Tunisia it was warmer and never snowed, and because Finland and Sweden were situated near each other. These explanations indicate that Jakob did not differentiate between the concepts of country, Earth and planet. Moreover, Jakob did not seem to differentiate between different meanings of the word "Earth," as he made drawings of the Earth with and without brown areas representing earth (soil) and talked about the earth where the ants lived. Although Jakob had pointed out Sweden and Tunisia in the same round object in his drawing, he said these countries were not [on] the same Earth. It was not until Jakob verbally explained his understanding of the concept Earth that it became evident that his drawings represented undifferentiated conceptions of country, Earth and planet.

Jahoda (1963) studied children's understanding of geographical concepts in relation to where the children were situated. Young children in Glasgow had a vague idea of Glasgow as

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something nearby, but usually not including their own immediate surroundings. Some children believed that Scotland was outside Glasgow. Jahoda also found examples of children describing countries or streets as towns and towns as countries. Jahoda perceived these children's organization of geographical concepts as minimal. He argued that children cannot be expected to understand the relationships between the concepts if they do not differentiate between them. In a wider context, in which children are situated in relation to country, Earth and planets in the solar system, similar problems may arise. In this study, Annika and Jakob appeared not to differentiate between their conception of Earth and their conception of country and planet. This could be concluded from their dialogue with the interviewer, but was not evident in their drawings, which appeared to adhere to conventional depictions of the Earth as a planet, alone or in the solar system.

Undifferentiated conceptual frameworks and an intellectually realistic depiction in a science fiction genre

[Insert figure 3 about here]

Alexandra (age 7) drew a round Earth with green and blue areas, one person and three boats. Then she made, in the same drawing, what she called "outer space" (Figure 3). She drew something that the researcher associates with the planet Saturn, because it is a round object with some kind of circles. The interviewer asked her about that.

I: […] What is it that you have drawn?

Alexandra: It is one such…I don't know what it is called.

I: Anyway, it is somewhere around, near the Earth.

Alexandra: There is the sun, isn't there?

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I: Yes, you may decide what you think there should be.

Alexandra: It should be near, because then the sun goes into the globe.

I: Does the sun go into the globe?

Alexandra: Yes, so it can be seen.

I: So it can be seen. By whom can it be seen?

Alexandra: Maybe by the people down here.

What did she mean by her expression, "Then the sun goes into the globe"? After she had made a second picture, the interviewer went back to talk about this again.

I: […] You said before that the sun, that we talked about before, when it was about outer space.

Alexandra: Yes.

I: And then you said that if we should see it, what should it do then?

Alexandra: It must be outside or it comes down, you know.

I: Outside…

Alexandra: Outside or comes down.

I: What is it outside?

Alexandra: Outside the globe.

Alexandra's picking up of the expression "outer space" may have strengthened her view of an "outside" in relation to the Earth. Her reference to an "outside" may be related to Nussbaum's, and Vosniadou's and Brewer's, research on children's understanding of the Earth. Nussbaum (1985) asserted that children may think of the Earth as a ball made up of two hemispheres, where people live on the flat surface of the lower solid part. Vosniadou and Brewer (1992) found that some children believe we live on a flat surface inside a hollow sphere. Alexandra drew something, which she called a flying saucer, referring to what she had seen in a computer game. The flying saucer indicated that the computer game she referred to was in the

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science fiction genre. Her second drawing showed the ground as seen from above. It can be compared to Erik's drawing, which had a magnifying glass over part of the Earth, to show people. The similarity is that people on the ground were shown from the same angle as the planet. The difference is that Alexandra also drew people and boats in her picture of the Earth in space. This indicates that she did not intend to differentiate, especially between distances, in her drawings.

Alexandra's reference to the sun as outside, going into and coming down in relation to the Earth indicate that she had not differentiated an astronomical framework of the Earth from a common sense framework. Her first drawing (Figure 3) was in an intellectually realistic mode of depiction, because of the different viewpoints from which the planets and the people were depicted. It was in a science fiction genre because of the flying saucer.

Summary

The explanations that Gunnar, Albert, Indra and Alexandra gave of their drawings of the Earth were in line with alternative conceptions of the Earth found in earlier research (Nussbaum, 1985; Vosniadou & Brewer, 1992). The interviews with Annika and Jakob indicated that these children did not differentiate between their conception of Earth and their conceptions of country and planet. This problem was related to the research findings on children's understanding of geographical concepts (Jahoda, 1963). There were many indications of that these children had not differentiated the astronomical framework of the planet Earth from the common sense framework of the Earth as nearby surroundings. Despite that the interviews with these children indicated that their drawings represented conceptions of the Earth that belonged to undifferentiated or unrelated frameworks; their drawings of the Earth could be connected to cultural conventions depicting the Earth as a globe and the

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ground (Gunnar, Indra), as a globe (Albert, Jakob), as the solar system (Annika), and as a sci-fi computer game (Alexandra).

When the interviewer asked if there were any people on the Earth, or where people were, some children added people to their drawing of a round Earth (Elin, Erik, Alexandra, and three others). This indicates that intellectually realistic drawings with more than one viewpoint were a possible mode of depiction to them.

Discussion

The assertion of Ivarsson, Schoultz and Säljö (2001), that drawings cannot be regarded as mirroring underlying conceptions, is in line with a socio-cultural theory that does not acknowledge personal conceptions. Because this study sought to understand how children represented their conceptions in drawing, it was a premise that children hold conceptions. Conceptions were regarded as contextualized in conceptual frameworks in cognitive contexts, and drawings were regarded as contextualized pictorial conventions in cultural contexts. This study indicated that children might contextualize their conceptions of the Earth in undifferentiated or unrelated frameworks and, at the same time, contextualize their drawings of the Earth in conventional modes of depicting the Earth. Thus, drawings cannot be anticipated to "mirror" conceptions that children hold; in this respect, this study agrees with the opinion of Ivarsson and colleagues. On the other hand, following Goodman (1976) in that the only criterion for pictorial representation is reference to an object, pictures can never be looked upon as "mirroring" what they represent. In this study, the "object" that the drawings referred to, i.e., the children's conceptions, were more diversified than what could have been expected before the children gave their explanations.

The drawings by the children in this study did not support the assumption of Siegal and colleagues (2004) that drawings as a means of grasping children's conception of the Earth

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would lead to an overrepresentation of a flat-Earth concept, because of children's difficulties in drawing spheres or their tendency to orient figures to a baseline. Many of the children drew people situated on a round Earth. In doing so they used an intellectually realistic mode of depiction with two different viewpoints in the same drawing (cf. Luquet, 1927/2001); the people were drawn in side view and from a shorter distance compared to the Earth on which they were situated. There was, however, probably reluctance in some children, to place people in their drawings of a round Earth, which may be explained by their choice a visual realistic mode of depiction.

The remarks by Dove and colleagues (1999) on children's clichéd images of mountains in their own study can be compared to drawings of the planet Earth. If children's drawings normally are connected to conventions (cf. Thomas, 1995), the drawings could also be described as clichés. In this study the children can be understood to have made clichéd drawings of the Earth. Some of their conceptions of the Earth and related phenomena were not conventional, and consequently were not shown in these clichéd drawings.

The results indicate that children seek a convention for depicting the Earth among existing conventions in their culture, and if they hold an alternative conception of the Earth, a suitable convention may not exist. At the beginning of the interview, Annika talked about the smaller circles around the sun as planets, and then expressed herself as if she was trying to conform to a convention. Her drawing also appeared to have been influenced by pictures of the solar system. Later in the interview, when the discussion went deeper into the character of the Earth, she referred to the smaller circles around the sun as different Earths. This change may have indicated that she had left the process of finding a pictorial convention in a cultural context and moved on to the process of contextualizing the concept of Earth in a conceptual framework in a cognitive context. This second process of contextualizing her conception of the Earth in a cognitive context may exemplify Jahoda's (1963) description of children's

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problems in relating concepts if they have not differentiated those concepts. Annika might not have differentiated the concept of planet from the concept of Earth. However, this case may also exemplify what Halldén (1999) called "error of application." It is probable that Annika may have chosen an explanation in which her drawing became relevant. Therefore, we must take a third kind of context, the situation, into account. Halldén (1999) argued that to contextualize a problem involves not only finding a relevant speech genre (in this study, understood as mode of depiction) in a cultural context and finding the appropriate conceptual framework in a cognitive context; it also involves finding an appropriate explanation in the present situation. The child's understanding of the situation determines the conception the child chooses from his or her repertoire of conceptions (Carvita & Halldén, 1994).

This study indicates an unclear relationship between children's choice of convention for depicting an object and their conception of the object. Also, that similar pictures may represent different conceptions. Elin and Erik explained that there were no people in their picture of a round Earth, because they could not be seen from that distance. Indra and Albert, on the other hand, explained that people were inside the round Earth that they hade drawn. An implication from this would be that drawings themselves are not an appropriate means for drawing conclusions about children's conceptions in research or in school situations. This concerns methods which collect and analyse drawings without children's own comments. When the drawings are used together with children's descriptions of their conceptions (e.g., Vosniadou & Brewer, 1992) they may have a complementary function or serve a purpose as something concrete to talk about.

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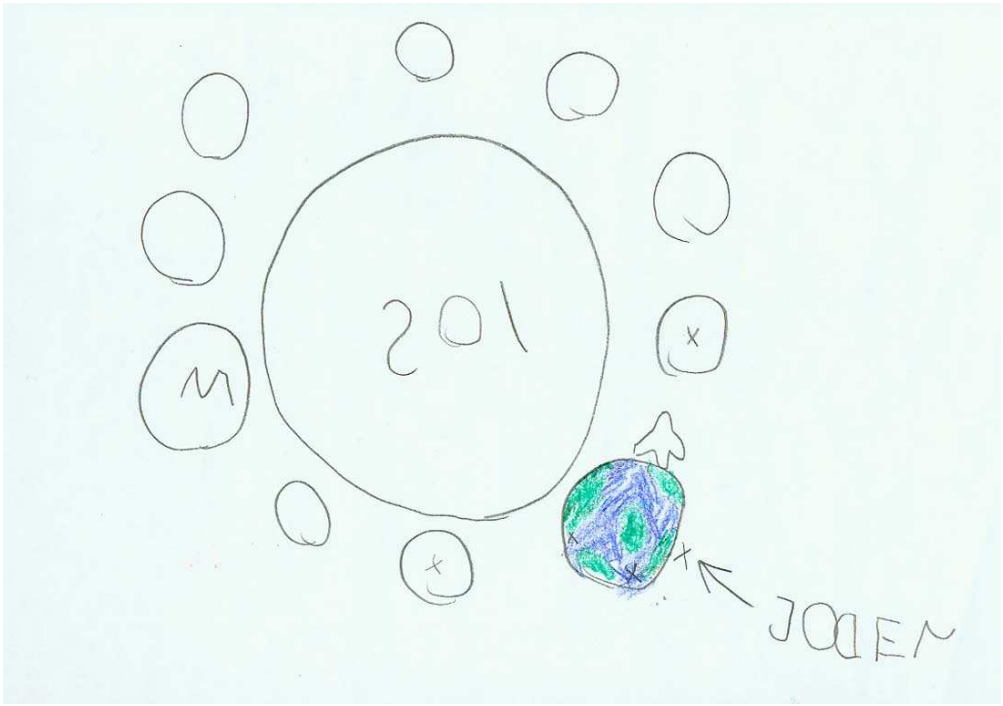

Figure 2. Annika's drawing.
289x203mm (96 x 96 DPI)

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Figure 3. Alexandra's first drawing.

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